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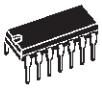
Jameco Part Number 57007

LM2902

LOW POWER QUAD OPERATIONAL AMPLIFIER

- WIDE GAIN BANDWIDTH: 1.3MHz
- INPUT COMMON-MODE VOLTAGE RANGE INCLUDES GROUND
- LARGE VOLTAGE GAIN: 100dB
- VERY LOW SUPPLY CURRENT/AMPLI: 375µA
- LOW INPUT BIAS CURRENT: 20nA
- LOW INPUT OFFSET CURRENT:2nA
- WIDE POWER SUPPLY RANGE: SINGLE SUPPLY: +3V TO +30V DUAL SUPPLIES: ±1.5V TO ±15V



N
DIP14
(Plastic Package)

D
SO14
(Plastic Micropackage)

P
TSSOP14
(Thin Shrink Small Outline Package)

DESCRIPTION

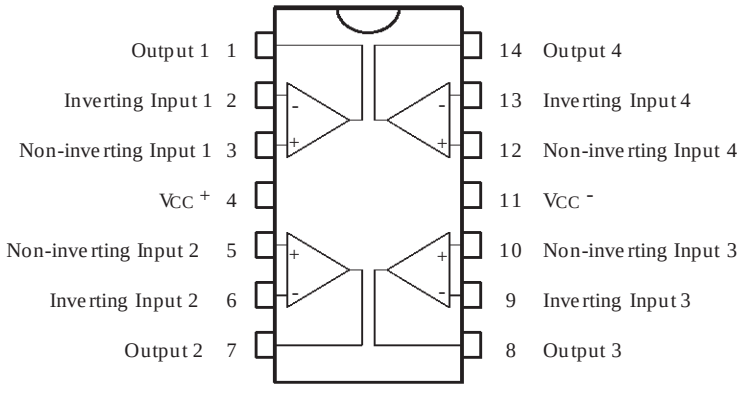
This circuit consists of four independent, high gain, internally frequency compensated operational amplifiers which were designed specially for automotive and industrial control systems. It operates from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

ORDER CODE

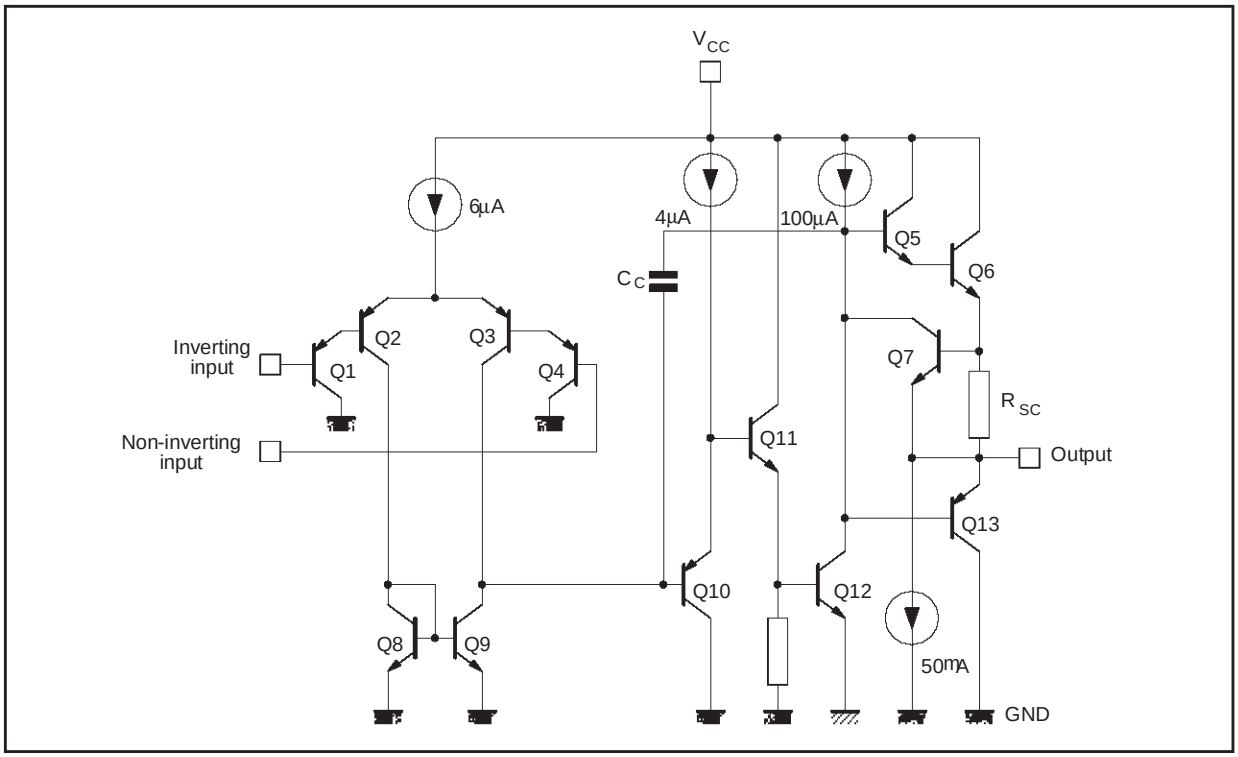
Part Number	Temperature Range	Package		
		N	D	P
LM2902	-40°C, +125°C	•	•	•

N = Dual in Line Package (DIP)
D = Small Outline Package (SO) - also available in Tape & Reel (DT)
P = Thin Shrink Small Outline Package (TSSOP) - only available in Tape & Reel (PT)

PIN CONNECTIONS (top view)



SCHEMATIC DIAGRAM (1/4 LM2902)



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	±16 to 32	V
V_{id}	Differential Input Voltage	+32	V
V_I	Input Voltage	-0.3 to +32	V
	Output Short-circuit to Ground [1]	Infinite	
p_{tot}	Power Dissipation N Suffix D Suffix	500 400	mW
I_{in}	Input Current [2]	50	mA
T_{oper}	Operating Free-Air Temperature Range	-40 to +125	°C
T_{stg}	Storage Temperature Range	-65 to +150	°C

1. Short-circuit from the output to V_{CC} can cause excessive heating if V_{CC} > 15V. The maximum output current is approximately 40mA independent of the magnitude of V_{CC}. Destructive dissipation can result from simultaneous short-circuit on all amplifiers.
2. This input current only exists when the voltage at any of the input leads is driven negative. It is due to the collector-base junction of the input PNP transistor becoming forward biased and thereby acting as input diodes clamps. In addition to this diode action, there is also NPN parasitic action on the IC chip. This transistor action can cause the output voltages of the Op-Amps to go to the V_{CC} voltage level (or to ground for a large overdrive) for the time duration than an input is driven negative. This is not destructive and normal output will set up again for input voltage higher than -0.3V.

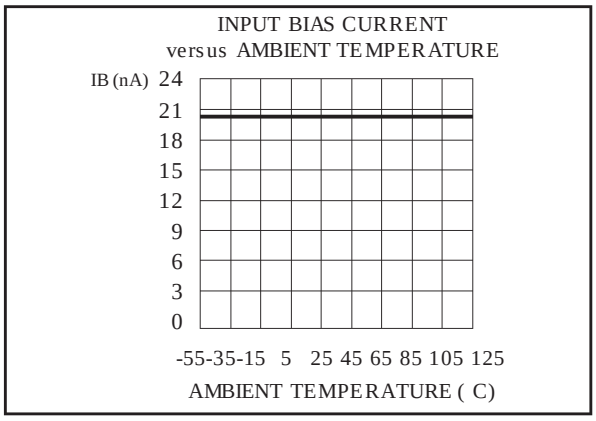
ELECTRICAL CHARACTERISTICS

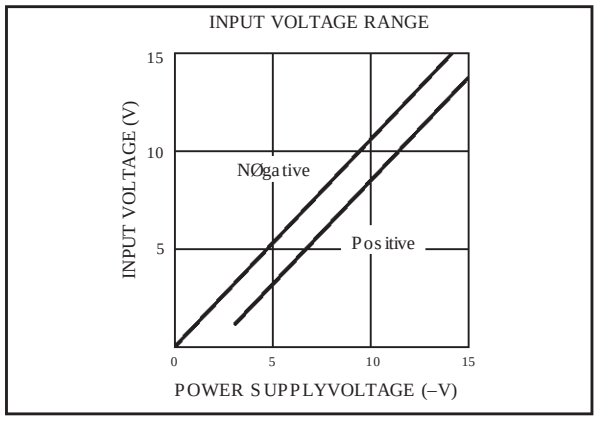
V_{CC}^+ = 5V, V_{cc}^- = Ground, V_O = 1.4V, T_{amb} = 25°C (unless otherwise specified)

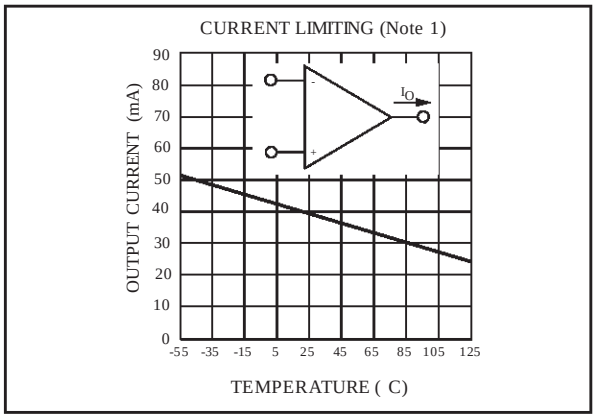
Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage [1] T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$.		2	7 9	mV
I_{io}	Input Offset Current T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$.		2	30 40	nA
I_{ib}	Input Bias Current [2] T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$.		20	150 300	nA
A_{vd}	Large Signal Voltage Gain V_{CC}^+ = +15V,R_L=2kΩ, V_O = 1.4V to 11.4V T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$.	 50 25	 100		V/mV
SVR	Supply Voltage Rejection Ratio (R_S ≤10kΩ) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$.	 65 65	 110		dB
I_{cc}	Supply Current, all Amp, no load T_{amb} = +25°C V_{CC} = +5V V_{CC} = +30V $T_{min} \le T_{amb} \le T_{max}$. V_{CC} = +5V V_{CC} = +30V		 0.7 1.5 0.8 1.5	 1.2 3 1.2 3	mA
V_{icm}	Input Common Mode Voltage Range (V_{cc}= +30V)[3] T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$.	 0 0		 V_{CC} -1.5 V_{CC} -2	V
CMR	Common-mode Rejection Ratio (R_S ≤10kΩ) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$.	 70 60	 80		dB
I_O	Output Short-circuit Current (V_{id} = +1V) V_{CC} = +15V, V_o = +2V	 20	 40	 70	mA
I_{sink}	Output Sink Current (V_{id} = -1V) V_{CC} = +15V, V_o = +2V V_{CC} = +15V, V_o = +0.2V	 10 12	 20 50		mA µA
V_{OH}	High Level Output Voltage (V_{cc} + 30V) T_{amb} = +25°C R_L = 2kΩ $T_{min} \le T_{amb} \le T_{max}$. T_{amb} = +25°C R_L = 10kΩ $T_{min} \le T_{amb} \le T_{max}$. ($V_{cc}$ + 5V), R_L = 2kΩ $T_{min} \le T_{amb} \le T_{max}$. T_{amb} = +25°C	 26 26 27 27 3.5 3	 27 28		V
V_{OL}	Low Level Output Voltage (R_L = 10kΩ) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$	 	 5	 20 20	mV
SR	Slew Rate V_{cc} = 15V, Vi = 0.5 to 3V, R_L = 2kΩ, C_L = 100pF, unity gain	 	 0.4	 	V/µs

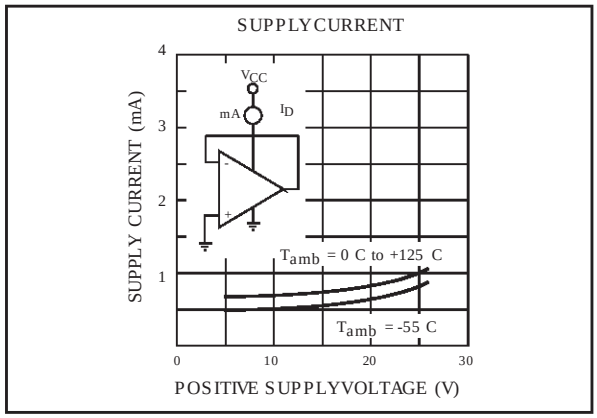
Symbol	Parameter	Min.	Typ.	Max.	Unit
GBP	Gain Bandwidth Product V_{cc} = 30V,V_{in} = 10mV, R_L = 2kΩ, C_L = 100pF		1.3		MHz
THD	Total Harmonic Distortion f = 1kHz, A_V = 20dB, R_L = 2kΩ, V_o = 2Vpp, C_L = 100pF, V_{cc} = 30V		0.015		%
e_n	Equivalent Input Noise Voltage f = 1kHz, R_S = 100Ω, V_{cc} = 30V		40		$\frac{nV}{\sqrt{Hz}}$
DV_{io}	Input Offset Voltage Drift		7	30	µV/°C
DI_{io}	Input Offset Current Drift		10	200	pA/°C
V_{O1}/V_{O2}	Channel Separation 4) 1kHz ≤ f ≤ 20kHz		120		dB

1. V_O = 1.4V, R_S = 0Ω, 5V < V_{CC}^+ < 30V, 0V < V_{ic} < V_{CC}^+ - 1.5V
2. The direction of the input current is out of the IC. This current is essentially constant, independent of the state of the output, so no loading charge change exists on the input lines
3. The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is V_{CC}^+ –1.5V, but either or both inputs can go to +32V without damage.
4. Due to the proximity of external components insure that coupling is not originating via stray capacitance between these external parts. This typically can be detected as this type of capacitance increases at higher frequences.

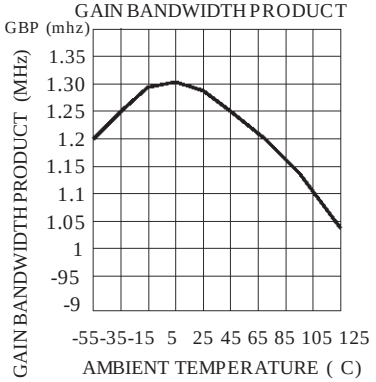




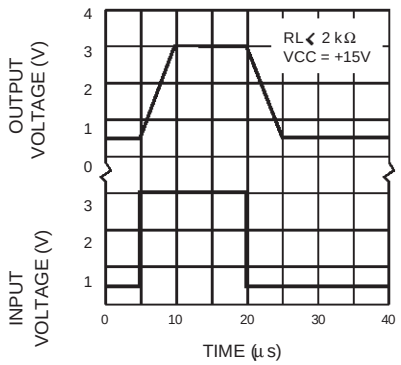




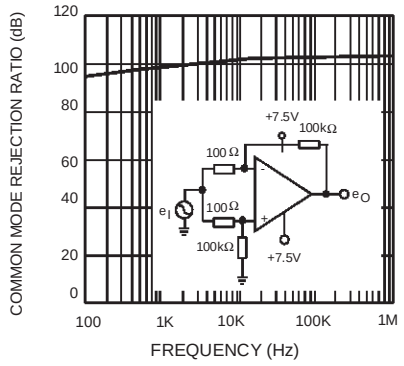
GAIN BANDWIDTH PRODUCT



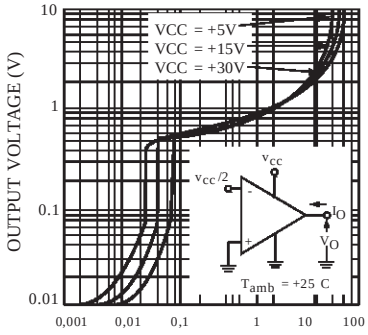
VOLAGE FOLLOWER PULSE RESPONSE



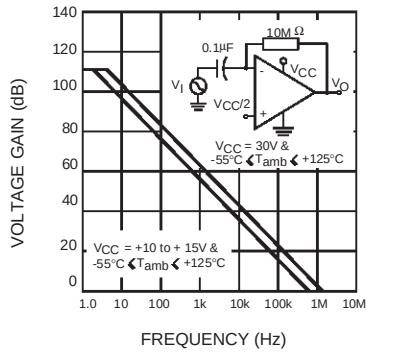
COMMON MODE REJECTION RATIO



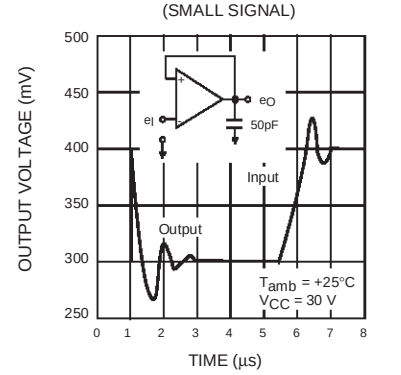
OUTPUT CHARACTERISTICS



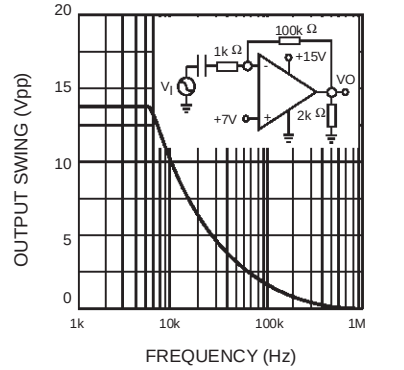
OPEN LOOP FREQUENCY RESPONSE (NOTE 3)



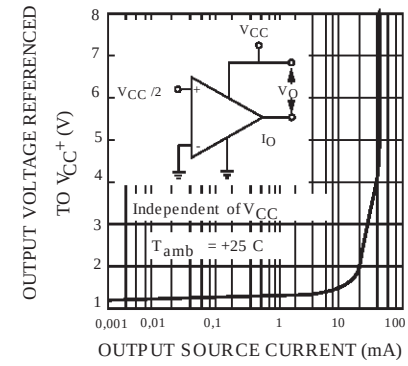
VOLTAGE FOLLOWER PULSSE RESPONSE (SMALL SIGNAL)

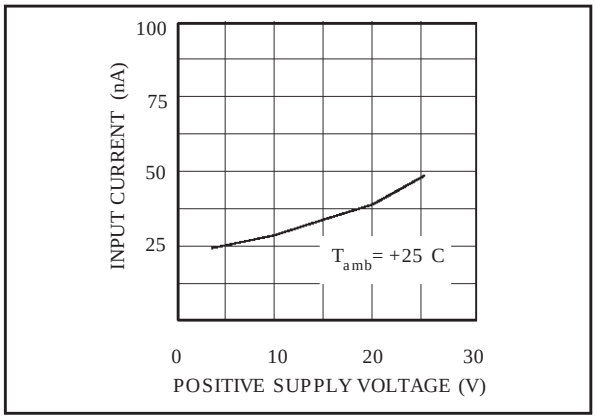


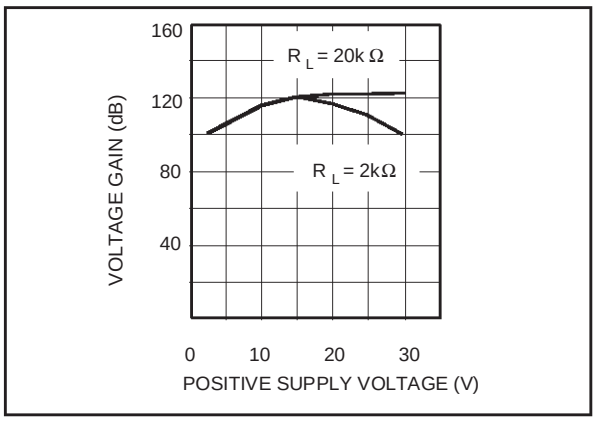
LARGE SIGNAL FREQUENCY RESPONSE

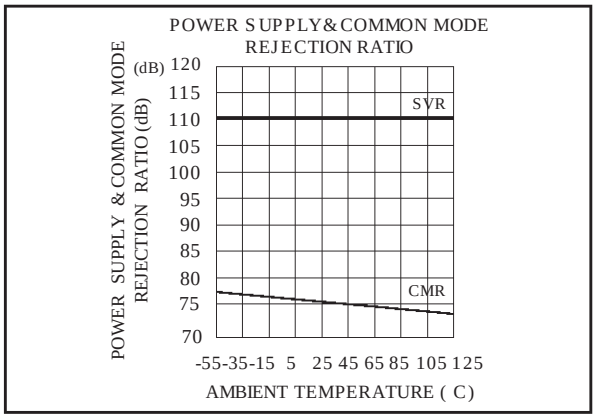


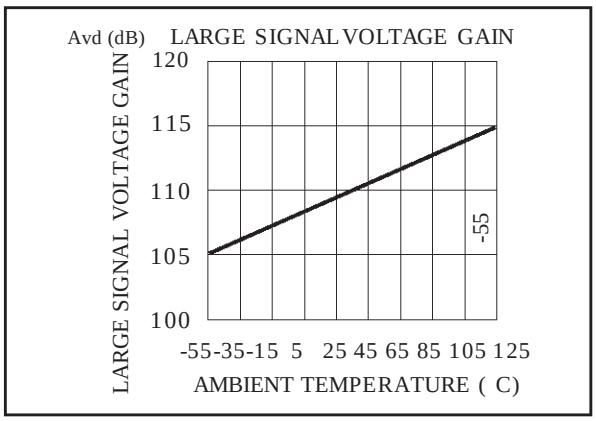
OUTPUT CHARACTERISTICS





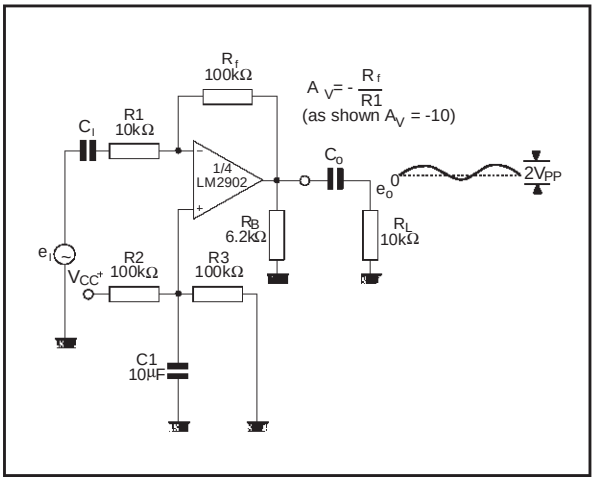




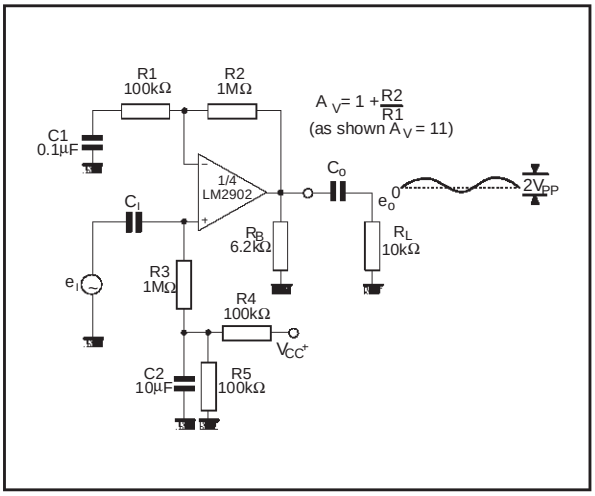


TYPICAL SINGLE - SUPPLY APPLICATIONS

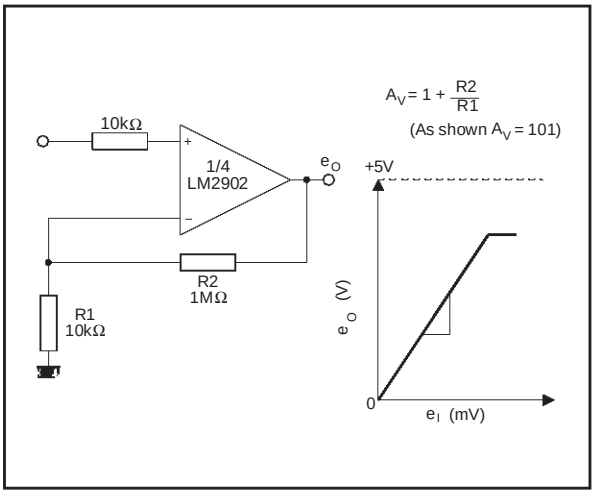
AC COUPLED INVERTING AMPLIFIER



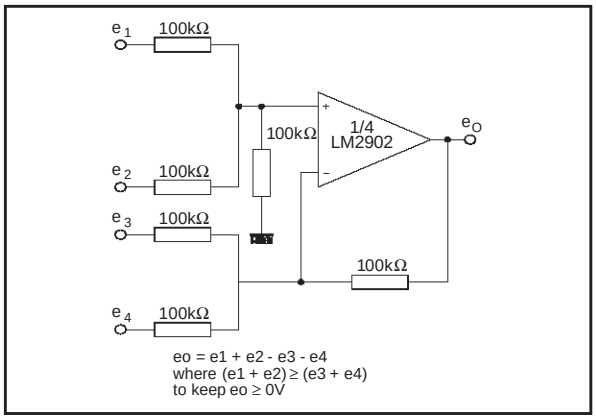
AC COUPLED NON-INVERTING AMPLIFIER



NON-INVERTING DC GAIN

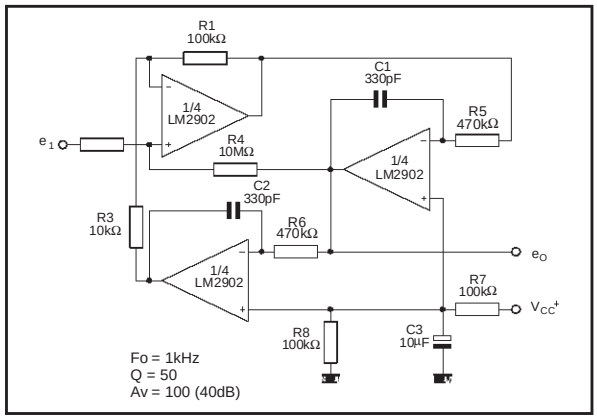


DC SUMMING AMPLIFIER



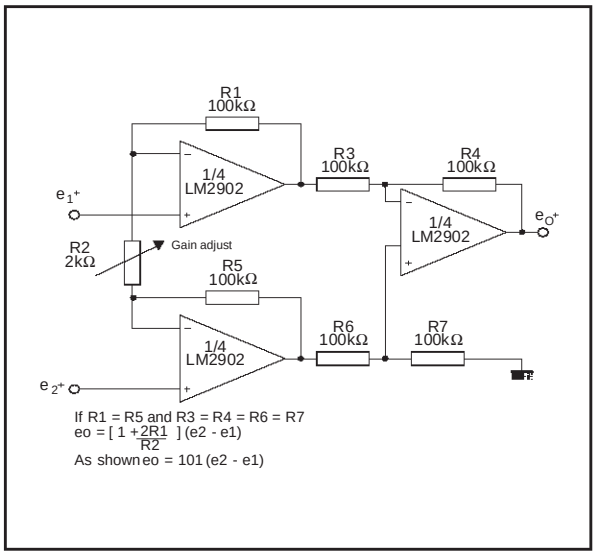
eo = e1 + e2 - e3 - e4
where (e1 + e2) ≥ (e3 + e4)
to keep eo ≥ 0V

ACTIVER BADPASS FILTER



Fo = 1kHz
Q = 50
Av = 100 (40dB)

HIGH INPUT Z ADJUSTABLE GAIN DC INSTRUMENTATION AMPLIFIER

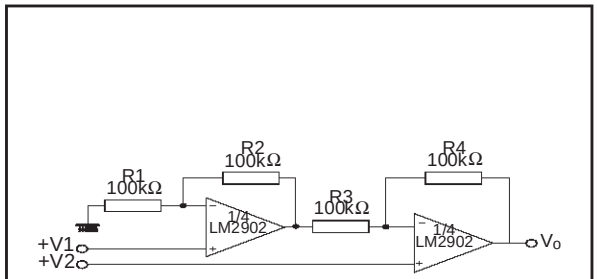


If R1 = R5 and R3 = R4 = R6 = R7

$eo = [\,1 + \frac{2R1}{R2}\,](e2 - e1)$

As shown eo = 101 (e2 - e1)

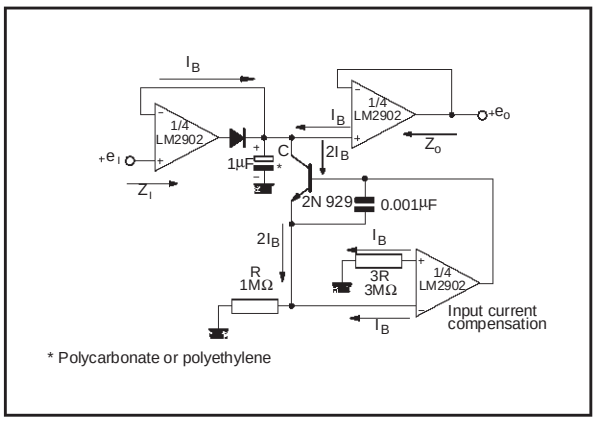
HIGH INPUT Z, DC DIFFERENTIAL AMPLIFIER



$eo = [\,1 + \frac{R4}{R3}\,](e2 - e1)$

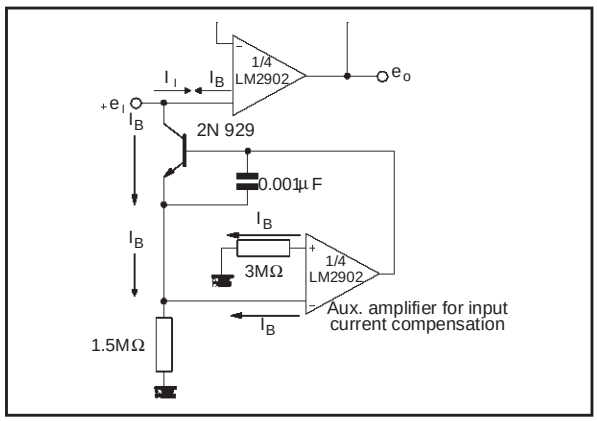
As shown eo = (e2 - e1)

LOW DRIFT PEAK DETECTOR



* Polycarbonate or polyethylene

USING SYMMETRICAL AMPLIFIERS TO REDUCE INPUT CURRENT (GENERAL CONCEPT)



MACROMODELS

** Standard Linear Ics Macromodels, 1993.

** CONNECTIONS :

* 1 INVERTING INPUT

* 2 NON-INVERTING INPUT

* 3 OUTPUT

* 4 POSITIVE POWER SUPPLY

* 5 NEGATIVE POWER SUPPLY

.SUBCKT LM2902 1 3 2 4 5 (analog)

****

.MODEL MDTH D IS=1E-8 KF=3.104131E-15 CJO=10F

* INPUT STAGE

CIP 2 5 1.000000E-12

CIN 1 5 1.000000E-12

EIP 10 5 2 5 1

EIN 16 5 1 5 1

RIP 10 11 2.600000E+01

RIN 15 16 2.600000E+01

RIS 11 15 2.003862E+02

DIP 11 12 MDTH 400E-12

DIN 15 14 MDTH 400E-12

VOFP 12 13 DC 0

VOFN 13 14 DC 0

IPOL 13 5 1.000000E-05

CPS 11 15 3.783376E-09

DINN 17 13 MDTH 400E-12

VIN 17 5 0.000000e+00

DINR 15 18 MDTH 400E-12

VIP 4 18 2.000000E+00

FCP 4 5 VOFP 3.400000E+01

FCN 5 4 VOFN 3.400000E+01

FIBP 2 5 VOFN 2.000000E-03

FIBN 5 1 VOFP 2.000000E-03

* AMPLIFYING STAGE

FIP 5 19 VOFP 3.600000E+02

FIN 5 19 VOFN 3.600000E+02

RG1 19 5 3.652997E+06

RG2 19 4 3.652997E+06

CC 19 5 6.000000E-09

DOPM 19 22 MDTH 400E-12

DONM 21 19 MDTH 400E-12

HOPM 22 28 VOUT 7.500000E+03

VIPM 28 4 1.500000E+02

HONM 21 27 VOUT 7.500000E+03

VINM 5 27 1.500000E+02

EOUT 26 23 19 5 1

VOUT 23 5 0

ROUT 26 3 20

COUT 3 5 1.000000E-12

DOP 19 25 MDTH 400E-12

VOP 4 25 2.242230E+00

DON 24 19 MDTH 400E-12

VON 24 5 7.922301E-01

.ENDS

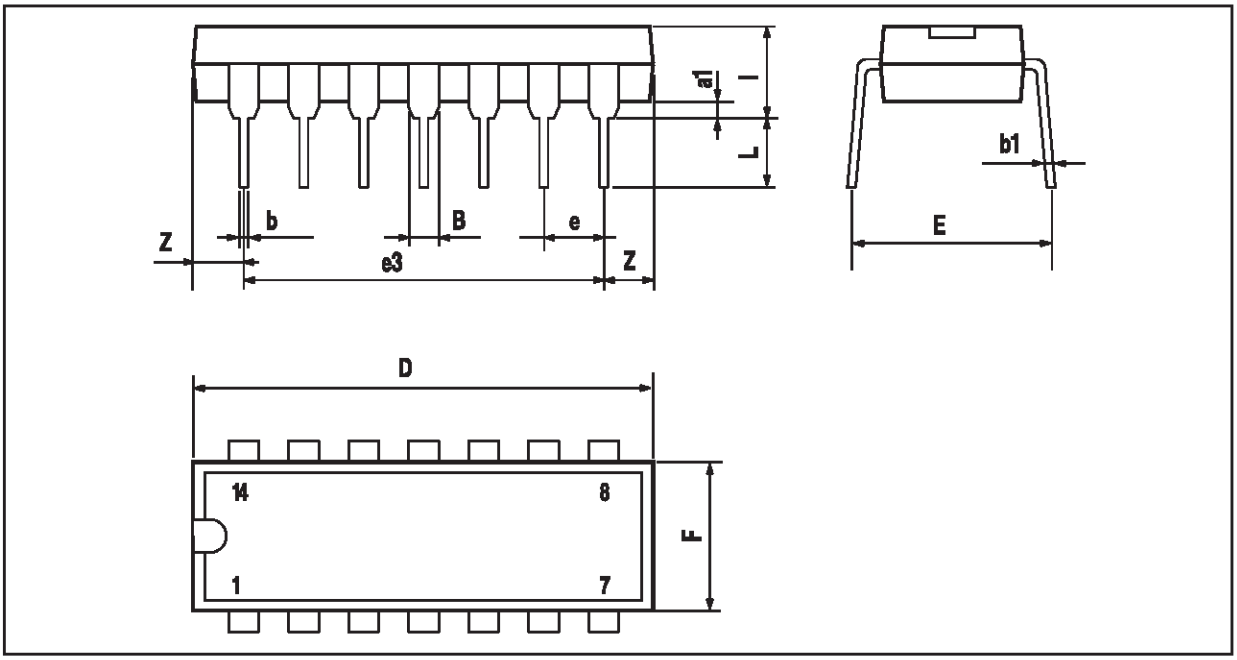
ELECTRICAL CHARACTERISTICS

V_{CC}^+ = 5V, V_{CC}- = 0V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Conditions	Value	Unit
V_{io}		0	mV
A_{vd}	R_L = 2kΩ	100	V/mV
I_{CC}	No load, per operator	350	µA
V_{icm}		-15 to +13.5	V
V_{OH}	R_L = 2kΩ (V_{CC}^+ = 15V)	+13.5	V
V_{OL}	R_L = 2kΩ	5	mV
I_{os}	V_O = +2V, V_{CC} = +15V	+40	mA
GBP	R_L = 2kΩ, C_L = 100pF	1.3	MHz
SR	R_L = 2kΩ, C_L = 100pF	0.4	V/µs

PACKAGE MECHANICAL DATA

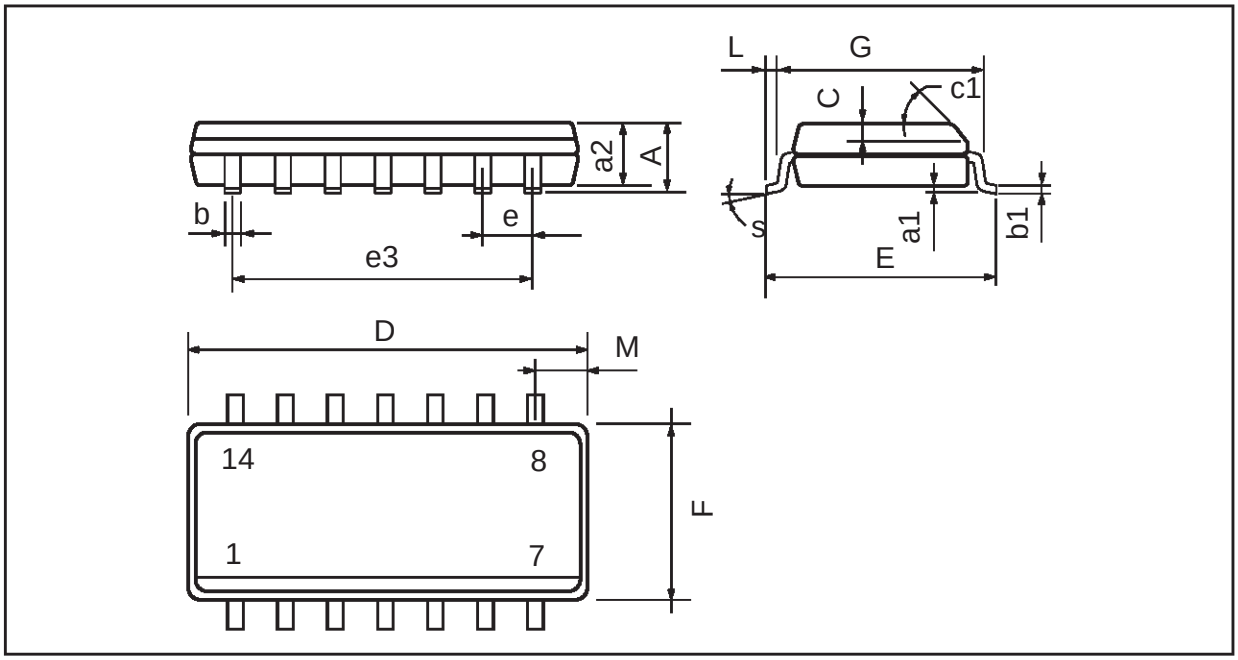
14 PINS - PLASTIC DIP



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
i			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100

PACKAGE MECHANICAL DATA

14 PINS - PLASTIC MICROPACKAGE (SO)

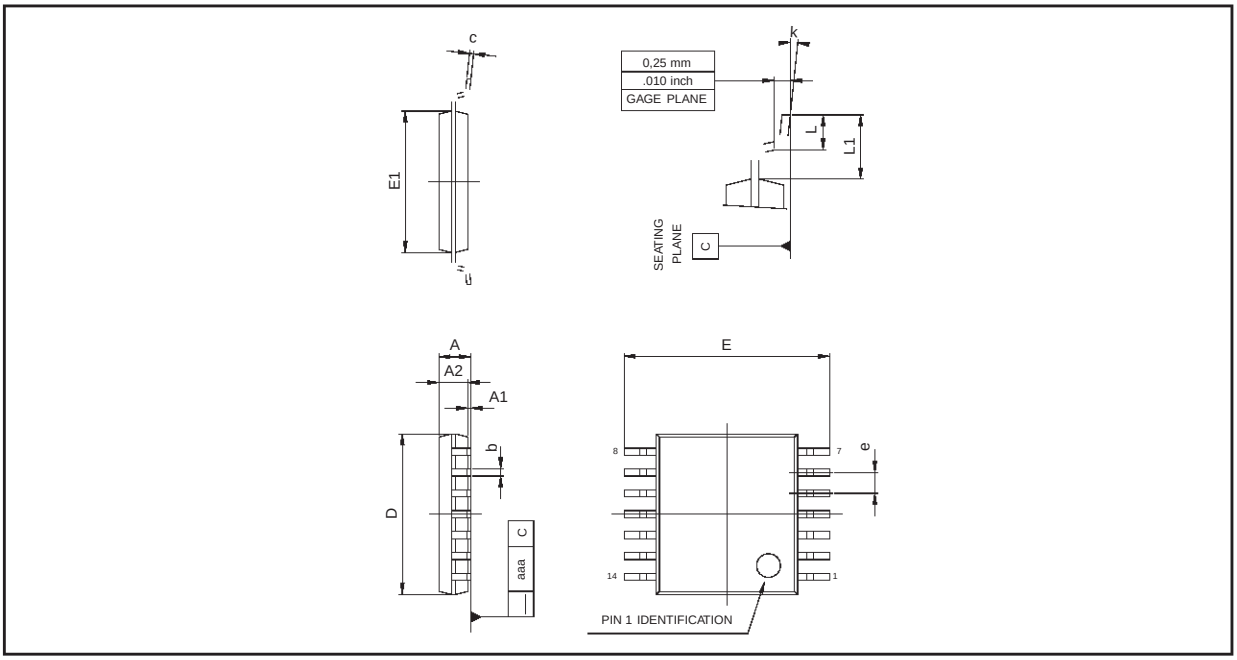


Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.2	0.004		0.008
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1	45° (typ.)					
D (1)	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F (1)	3.8		4.0	0.150		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.020		0.050
M			0.68			0.027
S	8° (max.)					

Note : (1) D and F do not include mold flash or protrusions - Mold flash or protrusions shall not exceed 0.15mm (.066 inc) ONLY FOR DATA BOOK.

PACKAGE MECHANICAL DATA

14 PINS -THIN SHRINK SMALL OUTLINE PACKAGE (TSSOP)



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.20			0.05
A1	0.05		0.15	0.01		0.006
A2	0.80	1.00	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.15
c	0.09		0.20	0.003		0.012
D	4.90	5.00	5.10	0.192	0.196	0.20
E		6.40			0.252	
E1	4.30	4.40	4.50	0.169	0.173	0.177
e		0.65			0.025	
k	0°		8°	0°		8°
L	0.450	0.600	0.750	0.018	0.024	0.030
L1		1.00			0.039	
aaa			0.100			0.004

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